

New Hampshire Volunteer Lake Assessment Program

2003 Interim Report for Mountain Lakes Haverhill



NHDES
Water Division
Watershed Management Bureau
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OBSERVATIONS & RECOMMENDATIONS

After reviewing data collected from **MOUNTAIN LAKES, HAVERHILL**, the program coordinators have made the following observations and recommendations:

We would like to thank your group for sampling your lake/pond once this summer. However, we would like to encourage your monitoring group to sample additional times each summer. Typically we recommend that monitoring groups sample three times per summer (once in June, July, and August). We understand that the number of sampling events you decide to conduct per summer will depend upon volunteer availability, your monitoring group's water monitoring goals and funding availability. However, with a limited amount of data it is difficult to determine accurate and representative water quality trends. Since weather patterns and activity in the watershed can change throughout the summer, from year to year, and even from hour to hour during a rain event, it is a good idea to sample the lake/pond at least once per month over the course of the season.

If you are having difficulty finding volunteers to help sample, or to pick-up or drop-off equipment at one of the laboratories, please give the VLAP Coordinator a call and we will try to help you work out an arrangement.

FIGURE INTERPRETATION

- **Figure 1 and Table 1:** The graphs in Figure 1 (Appendix A) show the historical and current year chlorophyll-a concentration in the water column. Table 1 (Appendix B) lists the maximum, minimum, and mean concentration for each sampling season that the lake/pond has been monitored through the program.

Chlorophyll-a, a pigment naturally found in plants, is an indicator of the algal abundance. Because algae are usually microscopic plants that contain chlorophyll-a, and are naturally found in lake ecosystems, the chlorophyll-a concentration measured in the water gives an estimation of the algal concentration or lake productivity.

The mean (average) summer chlorophyll-a concentration for New Hampshire's lakes and ponds is 7.02 mg/m³.

NORTH MOUNTAIN LAKE

The current year data (the top graph) show that the chlorophyll-a concentration in August was ***much less than*** the state mean.

Overall, visual inspection of the historical data trend line (the bottom graph) shows a ***decreasing*** in-lake chlorophyll-a trend, meaning that the concentration has ***improved*** since monitoring began in 1991. We hope this trend continues!

SOUTH MOUNTAIN LAKE

The current year data (the top graph) show that the chlorophyll-a concentration in August was ***less than*** the state mean.

Overall, visual inspection of the historical data trend line (the bottom graph) shows a ***variable*** in-lake chlorophyll-a trend, meaning that the concentration has ***fluctuated*** since monitoring began in 1990.

While algae are naturally present in all lakes/ponds, an excessive or increasing amount of any type is not welcomed. In freshwater lakes/ponds, phosphorus is the nutrient that algae depend upon for growth. Algal concentrations may increase with an increase in nonpoint sources of phosphorus loading from the watershed, or in-lake sources of phosphorus loading (such as phosphorus releases from the sediments). Therefore, it is extremely important for volunteer monitors to continually educate residents about how activities within the watershed can affect phosphorus loading and lake/pond quality.

- **Figure 2 and Table 3:** The graphs in Figure 2 (Appendix A) show historical and current year data for lake/pond transparency. Table 3 (Appendix B) lists the maximum, minimum and mean transparency data for each sampling season that the lake/pond has been monitored through the program.

Volunteer monitors use the Secchi-disk, a 20 cm disk with alternating black and white quadrants, to measure water clarity (how far a person can see into the water). Transparency, a measure of water clarity, can be affected by the amount of algae and sediment from erosion, as well as the natural colors of the water. **The mean (average) summer transparency for New Hampshire's lakes and ponds is 3.7 meters.**

NORTH MOUNTAIN LAKE

The current year data (the top graph) show that the in-lake transparency in August was ***greater than*** the state mean.

Overall, visual inspection of the historical data trend line (the bottom graph) shows an ***increasing*** trend for in-lake transparency, meaning that the transparency has ***slightly improved*** since monitoring began in 1991.

SOUTH MOUNTAIN LAKE

The current year data (the top graph) show that the in-lake transparency in August was ***less than*** the state mean.

Overall, visual inspection of the historical data trend line (the bottom graph) shows a ***stable*** trend for in-lake transparency, meaning that the transparency has ***remained approximately the same*** since monitoring began.

Typically, high intensity rainfall causes erosion of sediments into lakes/ponds and streams, thus decreasing clarity. Efforts should continually be made to stabilize stream banks, lake/pond shorelines, disturbed soils within the watershed, and especially dirt roads located immediately adjacent to the edge of tributaries and the lake/pond. Guides to Best Management Practices designed to reduce, and possibly even eliminate, nonpoint source pollutants, such as sediment loading, are available from DES upon request.

- **Figure 3 and Table 8:** The graphs in Figure 3 (Appendix A) show the amounts of phosphorus in the epilimnion (the upper layer) and the hypolimnion (the lower layer); the inset graphs show current year data. Table 8 (Appendix B) lists the annual maximum, minimum, and median concentration for each deep spot layer and each tributary since the lake/pond has joined the program.

Phosphorus is the limiting nutrient for plant and algae growth in New Hampshire's freshwater lakes and ponds. Too much phosphorus in a lake/pond can lead to increases in plant and algal growth over time. **The median summer total phosphorus concentration in the epilimnion (upper layer) of New Hampshire's lakes and ponds is 11 ug/L. The median summer phosphorus concentration in the hypolimnion (lower layer) is 14 ug/L.**

NORTH MOUNTAIN LAKE

The current year data for the epilimnion (the top inset graph) show that the total phosphorus concentration in August was ***less than*** the state median.

The current year data for the hypolimnion (the bottom inset graph) show that the total phosphorus concentration in August was ***much greater than*** the state median. However, the turbidity of the hypolimnetic sample was ***elevated*** (6.96 NTUs) on this sampling event, which suggests that the lake bottom may have been disturbed while sampling. When the lake/pond bottom is disturbed, organic matter which typically contains phosphorus is released into the water column. When collecting the hypolimnion sample, please check to make sure that there is no sediment in the Kemmerer Bottle before filling the sample bottles.

Overall, visual inspection of the historical data for the epilimnion (the upper graph) and the hypolimnion (the lower graph) show a ***variable*** total phosphorus trend, which means that the concentration has ***fluctuated*** since monitoring began.

SOUTH MOUNTAIN LAKE

The current year data for the epilimnion (the top inset graph) show that the total phosphorus concentration in August was ***slightly greater than*** the state median.

The current year data for the hypolimnion (the lower inset graph) show that the total phosphorus concentration in August was ***slightly less than*** the state median.

Overall, visual inspection of the historical data for the epilimnion and the hypolimnion show a ***variable*** total phosphorus trend, which means that the concentration has ***fluctuated*** since monitoring began.

One of the most important approaches to reducing phosphorus loading to a waterbody is to continually educate watershed residents about its sources and how excessive amounts can adversely impact the ecology and value of lakes and ponds. Phosphorus sources within a lake or pond's watershed typically include septic systems, animal waste, lawn fertilizer, road and construction erosion, and natural wetlands.

TABLE INTERPRETATION

➤ **Table 2: Phytoplankton**

Table 2 (Appendix B) lists the current and historical phytoplankton species observed in the lake/pond.

The dominant phytoplankton species observed at the **NORTH MOUNTAIN LAKE** deep spot this year were ***Asterionella* (a diatom)**, ***Gleocystis* (a green algae)**, and ***Dinobryon* (a golden-brown algae)**.

The dominant phytoplankton species observed at the **SOUTH MOUNTAIN LAKE** deep spot this year were ***Dinobryon* (a golden-brown algae)**, ***Chrysosphaerella* (a golden-brown algae)**, and ***Rhizosolenia* (a diatom)**.

Phytoplankton populations undergo a natural succession during the growing season (Please refer to the “Biological Monitoring Parameters” section of this report for a more detailed explanation regarding seasonal plankton succession). Diatoms and golden-brown algae are typical in New Hampshire’s less productive lakes and ponds.

➤ **Table 2: Cyanobacteria (Blue-green algae)**

A small amount of the cyanobacterium ***Anabaena*** was observed in the **NORTH MOUNTAIN LAKE** and **SOUTH MOUNTAIN LAKE** August sample. ***This species, if present in large amounts, can be toxic to livestock, wildlife, pets, and humans.***

Cyanobacteria can reach nuisance levels when excessive nutrients and favorable environmental conditions occur. During September of 2003, a few lakes and ponds in the southern portion of the state experienced cyanobacteria blooms. This was likely due to nutrient loading to these waterbodies. As mentioned previously, many weeks during the Spring and Summer of 2003 were rainy, which likely resulted in a large amount of nutrient loading to surface waters.

The presence of cyanobacteria serves as a reminder of the lake’s/pond’s delicate balance. Watershed residents should continue to act proactively to reduce nutrient loading into the lake/pond by eliminating fertilizer use on lawns, keeping the lake/pond shoreline natural, re-vegetating cleared areas within the watershed, and properly maintaining septic systems and roads.

In addition, residents should also observe the lake/pond in September and October during the time of fall turnover (lake mixing) to document any algal blooms that may occur. Cyanobacteria (blue-green algae) have the ability to regulate their depth in the water

column by producing or releasing gas from vesicles. However, occasionally lake mixing can affect their buoyancy and cause them to rise to the surface and bloom. Wind and currents tend to “pile” cyanobacteria into scums that accumulate in one section of the lake/pond. If a fall bloom occurs, please contact the VLAP Coordinator.

➤ **Table 4: pH**

Table 4 (Appendix B) presents the in-lake and tributary current year and historical pH data.

pH is measured on a logarithmic scale of 0 (acidic) to 14 (basic). pH is important to the survival and reproduction of fish and other aquatic life. A pH below 5.5 severely limits the growth and reproduction of fish. A pH between 6.5 and 7.0 is ideal for fish. The mean pH value for the epilimnion (upper layer) in New Hampshire’s lakes and ponds is **6.5**, which indicates that the surface waters in state are slightly acidic. For a more detailed explanation regarding pH, please refer to the “Chemical Monitoring Parameters” section of this report.

At the **NORTH MOUNTAIN LAKE** deep spot, the pH at the deep spot this season ranged from **6.57** in the hypolimnion to **7.22** in the epilimnion which means that the water is ***slightly acidic near the lake bottom and slightly basic near the surface.***

At the **SOUTH MOUNTAIN LAKES** deep spot, the pH at the deep spot this season ranged from **6.48** in the hypolimnion to **7.02** in the epilimnion, which means that the water is ***slightly acidic near the lake bottom and approximately neutral near the surface.***

When organic matter near the lake bottom is decomposed, acidic by-products are produced, which likely explains the lower pH (meaning higher acidity) near the lake bottom.

Due to the presence of granite bedrock in the state and the deposition of acid rain, there is not much that can be done to effectively increase lake/pond pH.

➤ **Table 5: Acid Neutralizing Capacity**

Table 5 (Appendix B) presents the current year and historical epilimnetic ANC for each year the lake/pond has been monitored through VLAP.

Buffering capacity or ANC describes the ability of a solution to resist changes in pH by neutralizing the acidic input to the lake. The mean

ANC value for New Hampshire's lakes and ponds is **6.7 mg/L**, which indicates that many lakes and ponds in the state are "highly sensitive" to acidic inputs. For a more detailed explanation, please refer to the "Chemical Monitoring Parameters" section of this report.

The Acid Neutralizing Capacity (ANC) of the epilimnion (the upper layer) of **NORTH** and **SOUTH MOUNTAIN LAKES** continues to remain **greater than** the state mean (11.70 and 14.40 mg/L, respectively). Specifically, this means that the surface waters of each lake have a "**low vulnerability**" to acidic inputs (such as acid precipitation).

➤ **Table 6: Conductivity**

Table 6 (Appendix B) presents the current and historical conductivity values for tributaries and in-lake data. Conductivity is the numerical expression of the ability of water to carry an electric current. The mean conductivity value for New Hampshire's lakes and ponds is **62.1 uMhos/cm**. For a more detailed explanation, please refer to the "Chemical Monitoring Parameters" section of this report.

The conductivity has **increased** in **NORTH** and **SOUTH MOUNTAIN LAKES and the inlets** since monitoring began (Table 6). In addition, the epilimnetic conductivity in both basins is **greater than** the state mean.

Typically, sources of increased conductivity are due to human activity. These activities include septic systems that fail and leak leachate into the groundwater (and eventually into the tributaries and the lake/pond), agricultural runoff, and road runoff (which contains road salt during the spring snow melt). New development in the watershed can alter runoff patterns and expose new soil and bedrock areas, which could contribute to increasing conductivity. In addition, natural sources, such as iron deposits in bedrock, can influence conductivity. It is possible that the lower than normal amount rainfall during the latter-half of the summer reduced tributary and lake flushing, which allowed pollutants and ions to build up and resulted in elevated conductivity levels.

We recommend that your monitoring group conduct stream surveys and storm event sampling along the inlet(s) with elevated conductivity (in particular, **MONTEAU INLET**, which is a tributary to **SOUTH MOUNTAIN LAKE**) so that we can determine what may be causing the increases.

For a detailed explanation on how to conduct rain event and stream surveys, please refer to the 2002 VLAP Annual Report "Special Topic

Article”, or contact the VLAP Coordinator.

➤ **Table 8: Total Phosphorus**

Table 8 (Appendix B) presents the current year and historical total phosphorus data for in-lake and tributary stations. Phosphorus is the nutrient that limits the algae’s ability to grow and reproduce. Please refer to the “Chemical Monitoring Parameters” section of this report for a more detailed explanation.

The total phosphorus concentration in the **MONTEAU INLET** was **relatively low** on the August sampling event (9 ug/L). However, this inlet has had a history of **elevated** and **fluctuating** phosphorus concentrations. As discussed previously, we recommend that your monitoring group conduct a stream survey and stormwater sampling along this inlet so that we can determine what may be causing the decrease in quality.

➤ **Table 9 and Table 10: Dissolved Oxygen and Temperature Data**

Table 9 (Appendix B) shows the dissolved oxygen/temperature profile(s) for the 2003 sampling season. Table 10 (Appendix B) shows the historical and current year dissolved oxygen concentration in the hypolimnion (lower layer). The presence of dissolved oxygen is vital to fish and amphibians in the water column and also to bottom-dwelling organisms. Please refer to the “Chemical Monitoring Parameters” section of this report for a more detailed explanation.

The dissolved oxygen concentration was **low in the hypolimnion** at the deep spot of **NORTH** and **SOUTH MOUNTAIN LAKES** this season. As stratified lakes/ponds age, oxygen becomes **depleted** in the hypolimnion (the lower layer) by the process of decomposition. Specifically, the loss of oxygen in the hypolimnion results primarily from the process of biological breakdown of organic matter (i.e.; biological organisms use oxygen to break down organic matter), both in the water column and particularly at the bottom of the lake/pond where the water meets the sediment. When oxygen levels are depleted to less than 1 mg/L in the hypolimnion (**as it was this season and in many past seasons**), the phosphorus that is normally bound up in the sediment may be re-released into the water column.

The **low** oxygen level in the hypolimnion is a sign of the lake’s/pond’s **aging**. This year the DES biologist conducted the temperature/dissolved oxygen profile in **August**. We recommend that the annual biologist visit for the 2004 sampling season be scheduled during **June** so that we can determine if oxygen is depleted in the hypolimnion **earlier** in the sampling season.

➤ **Table 11: Turbidity**

Table 11 (Appendix B) lists the current year and historical data for in-lake and tributary turbidity. Turbidity in the water is caused by suspended matter, such as clay, silt, and algae. Water clarity is strongly influenced by turbidity. Please refer to the “Other Monitoring Parameters” section of this report for a more detailed explanation.

As discussed previously, the turbidity in the **NORTH MOUNTAIN LAKE** hypolimnion was **elevated** on the August sampling event, which suggests that the lake bottom may have been disturbed while sampling.

DATA QUALITY ASSURANCE AND CONTROL

Annual Assessment Audit:

During the annual visit to your lake/pond, the biologist conducted a “Sampling Procedures Assessment Audit” for your monitoring group. Specifically, the biologist observed the performance of your monitoring group while sampling and filled out an assessment audit sheet to document the ability of the volunteer monitors to follow the proper field sampling procedures (as outlined in the VLAP Monitor’s Field Manual). This assessment is used to identify any aspects of sample collection in which volunteer monitors are not following the proper procedures, and also provides an opportunity for the biologist to retrain the volunteer monitors as necessary. This will ultimately ensure that the samples that the volunteer monitors collect are truly representative of actual lake and tributary conditions.

Overall, your monitoring group did an **excellent** job collecting samples on the annual biologist visit this season! Specifically, the members of your monitoring group followed the proper field sampling procedures and there was no need for the biologist to provide additional training. Keep up the good work!

NOTES

NORTH STATION

- **Biologist’s Note (8/7/03):** The total phosphorous and turbidity level of the hypolimnion (lower layer sample) was elevated which suggests that the lake bottom was disturbed by

the Kemmerer bottle, anchor or wind while sampling.

USEFUL RESOURCES

Acid Deposition Impacting New Hampshire's Ecosystems, ARD-32, NHDES Fact Sheet, (603) 271-3505, or www.des.state.nh.us/factsheets/ard/ard-32.htm. Center, and NHDES (603) 271-3505.

Best Management Practices to Control Nonpoint Source Pollution: A Guide for Citizens and Town Officials, NHDES-WD 97-8, NHDES Booklet, (603) 271-3503.

Camp Road Maintenance Manual: A Guide for Landowners. Kennebec Soil and Water Conservation District, 1992, (207) 287-3901.

Comprehensive Shoreland Protection Act, RSA 483-B, WD-SP-5, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/sp/sp-5.htm.

Cyanobacteria in New Hampshire Waters Potential Dangers of Blue-Green Algae Blooms, NHDES Fact Sheet, (603) 271-3505, or www.des.state.nh.us/factsheets/wmb/wmb-10.htm.

Erosion Control for Construction in the Protected Shoreland Buffer Zone, WD-SP-1, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/sp/sp-1.htm

Impacts of Development Upon Stormwater Runoff, WD-WQE-7, NHDES Fact Sheet, (603) 271-3503, or www.des.state.nh.us/factsheets/wqe/wqe-7.htm

Lake Protection Tips: Some Do's and Don'ts for Maintaining Healthy Lakes, WD-BB-9, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/bb/bb-9.htm.

Management of Canada Geese in Suburban Areas: A Guide to the Basics, Draft Report, NJ Department of Environmental Protection Division of Watershed Management, March 2001, www.state.nj.us/dep/watershedmgt/DOCS/BMP_DOCS/Goosedraft.pdf.

Proper Lawn Care In the Protected Shoreland, The Comprehensive Shoreland Protection Act, WD-SP-2, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/sp/sp-2.htm.

Road Salt and Water Quality, WD-WMB-4, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/wmb/wmb-4.htm.

Sand Dumping - Beach Construction, WD-BB-15, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/bb/bb-15.htm.

Through the Looking Glass: A Field Guide to Aquatic Plants. North American Lake Management Society, 1988, (608) 233-2836 or www.nalms.org.

OBSERVATIONS AND RECOMMENDATIONS

2003

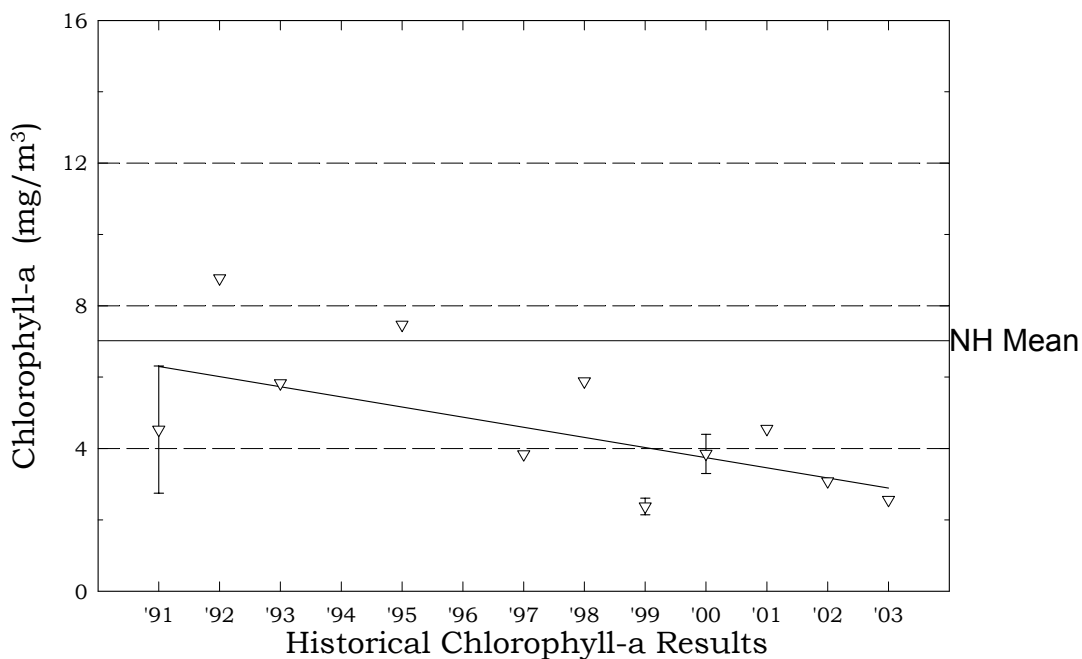
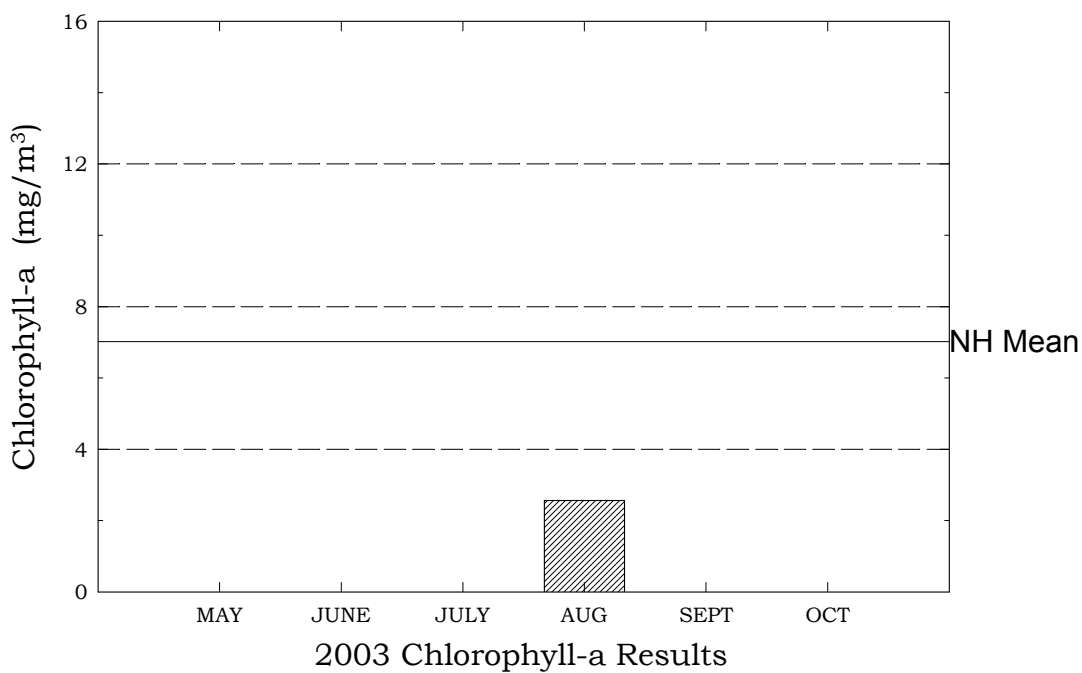
Weed Watchers: An Association to Halt the Spread of Exotic Aquatic Plants, WD-BB-4, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/bb/bb-4.htm.

APPENDIX A

GRAPHS

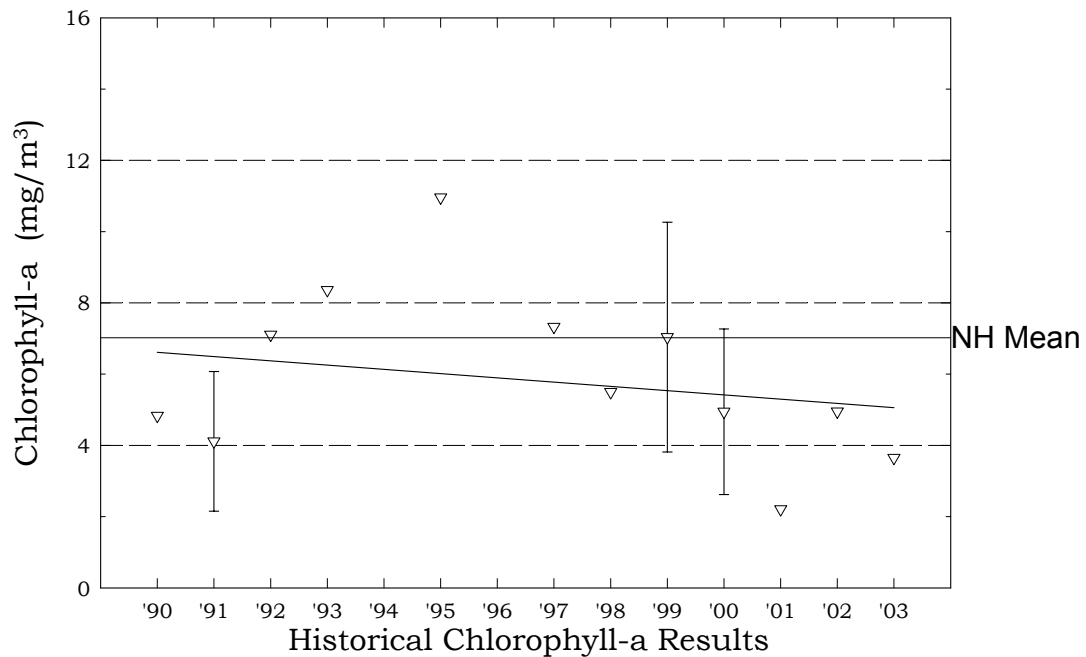
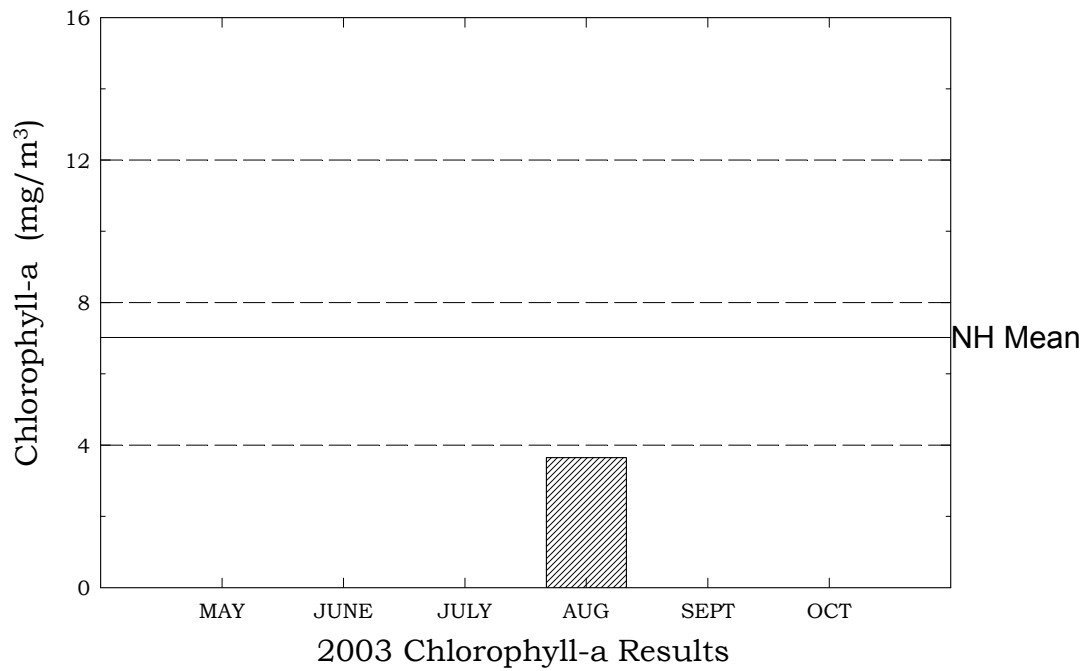
Mountain Lake, North, Haverhill

Figure 1. Monthly and Historical Chlorophyll-a Results



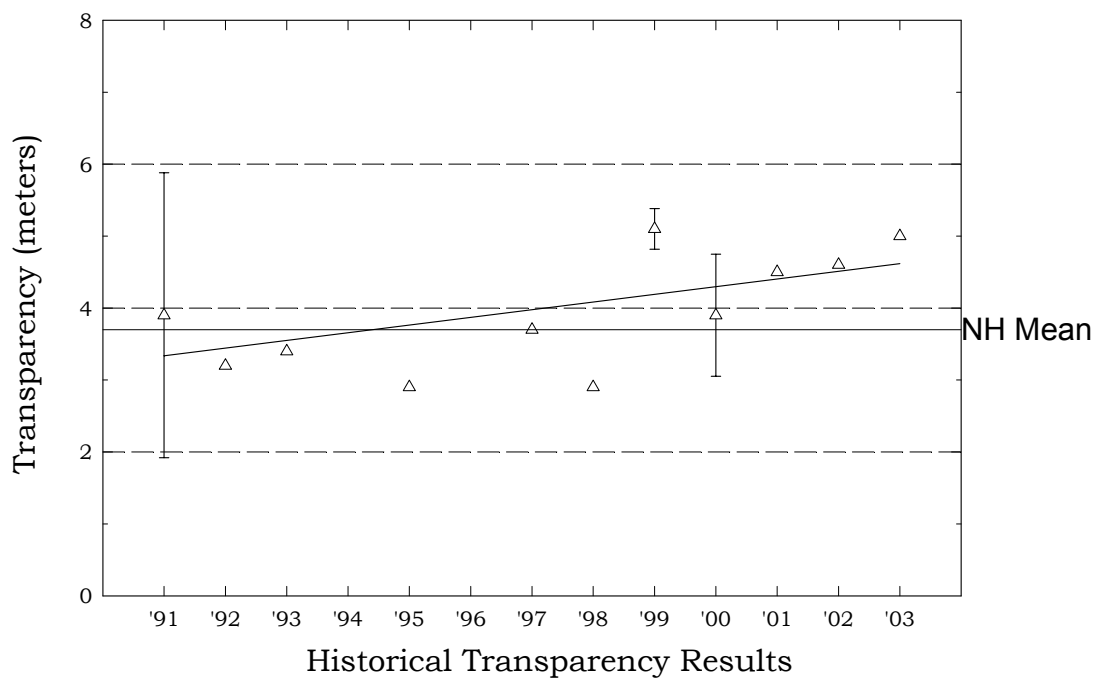
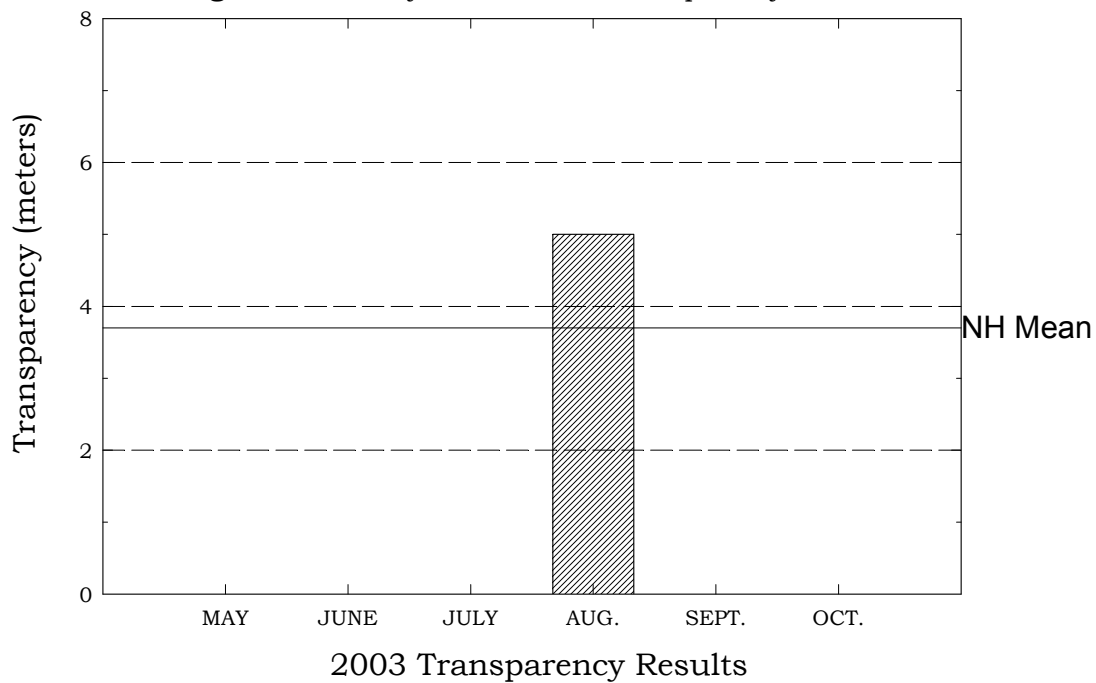
Mountain Lake, South, Haverhill

Figure 1. Monthly and Historical Chlorophyll-a Results



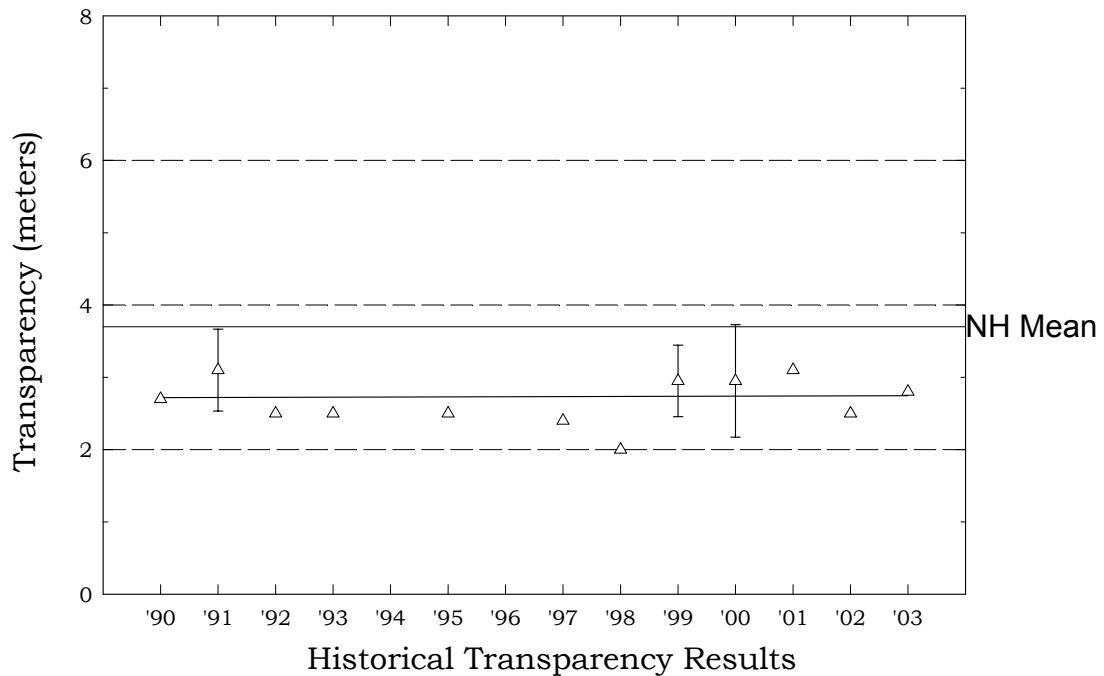
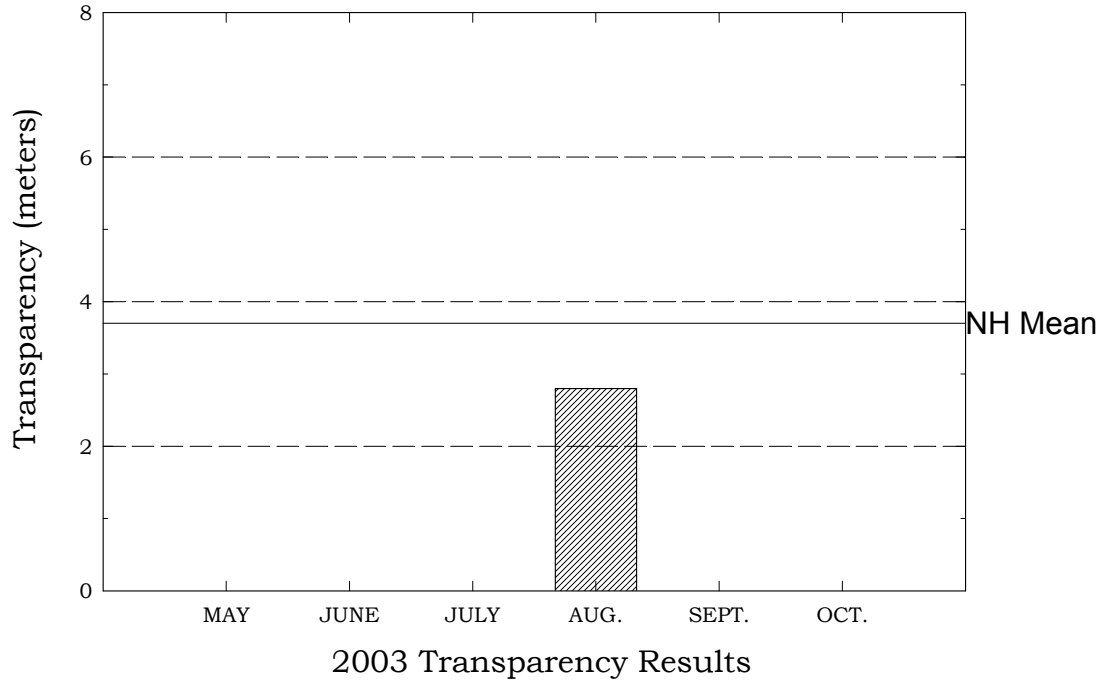
Mountain Lake, North, Haverhill

Figure 2. Monthly and Historical Transparency Results



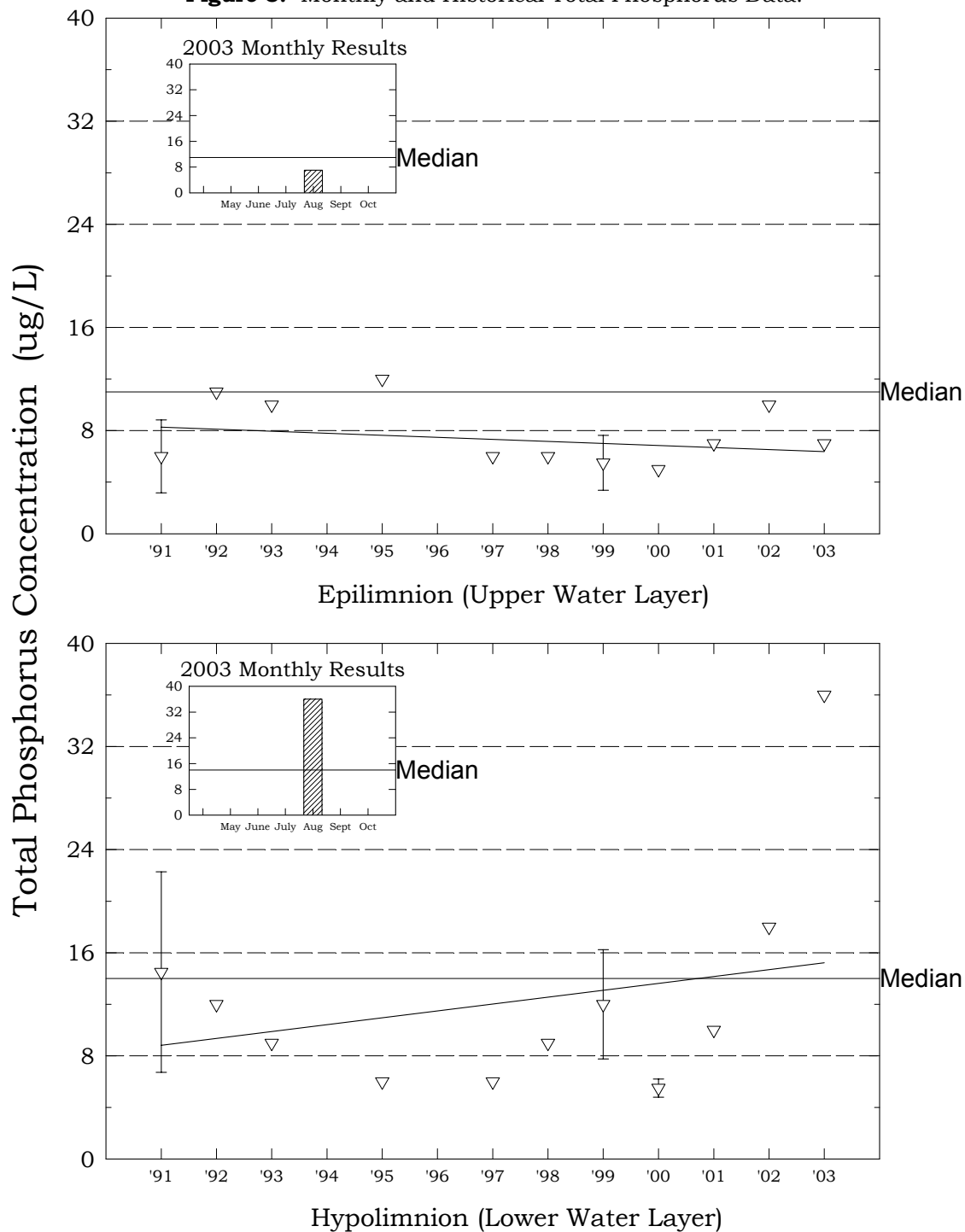
Mountain Lake, South, Haverhill

Figure 2. Monthly and Historical Transparency Results



Mountain Lake, North, Haverhill

Figure 3. Monthly and Historical Total Phosphorus Data.



Mountain Lake, South, Haverhill

Figure 3. Monthly and Historical Total Phosphorus Data.

